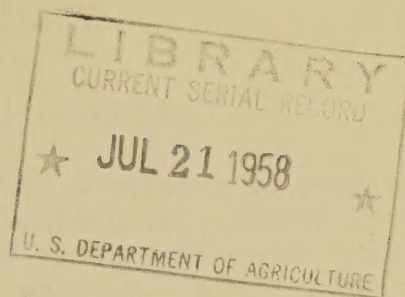


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PROCEEDINGS

INTERIM CONFERENCE ON COTTONSEED MEAL QUALITY

AS RELATED TO PROCESSING

January 24 and 25, 1955

Southern Regional Research Laboratory
Southern Utilization Research Branch
Agricultural Research Service
U. S. Department of Agriculture

New Orleans, Louisiana

Afternoon Session

January 25, 1955

Compiled and edited by W. H. King and A. M. Altschul

Summary of Conference

Morning Session: January 24; A. M. Altschul, Presiding

The conference was opened by Mr. A. L. Ward and a welcome to participants was given by Dr. C. H. Fisher, Chief, Southern Utilization Research Branch. Dr. A. M. Altschul outlined the background of the meeting which is summarized in the proceedings for the January 25 afternoon session. After appointment of resolutions committees by Dr. Altschul, the technical program was begun by those who had previously agreed to discuss the subjects on the agenda for the conference.

Conference Subjects

I. Toxicity

- A. Poultry
- B. Swine

What is the level of free gossypol in the diet which results in toxic symptoms or interference with growth?

Are there other materials beside gossypol which are responsible for toxicity?

Are there breed differences in both poultry and swine which influence the answers to the above questions?

II. Chemical and biological methods of evaluation

To what extent do different methods for biological evaluation of protein quality agree when applied to the same cottonseed meal?

What correlation exists between nutritive value and chemical characteristics, such as: (a) Nitrogen solubility; (b) total gossypol content; (c) enzyme digestion tests; and (d) others?

III. Use of cottonseed meal and cottonseed meal-soybean meal mixtures in poultry and swine rations

The resolution adopted at the third conference on cottonseed meal read as follows:

"A. Results presented thus far indicate that chick and broiler rations containing cottonseed meal and soybean meal in equal proportions on a nitrogen basis are equal or superior to rations based on either cottonseed meal or soybean alone, when the cottonseed meal used has 0.04% or less of free gossypol and 75% or more of nitrogen solubility in 0.02N NaOH solution."

"Nutrition investigators representing industrial, federal, and state organizations are invited to conduct experiments based on this statement using cottonseed meal of known processing history and chemical characteristics and soybean meal of high quality."

"B. Preliminary indications are, insofar as free gossypol is concerned, that cottonseed meals having 0.04% or less of free gossypol can be fed in balanced diets for chicks, broilers, and swine."

What new information do we have on the use of cottonseed meal as the major source of protein in rations for poultry and swine?

What new information do we have on the use of cottonseed meal-soybean meal mixtures in poultry and swine rations?

IV. New approaches to processing which may result in the production of superior quality products

What new developments are there on this subject?

V. Bound gossypol

What is the chemical nature of bound gossypol?

What is the nutritive significance of bound gossypol?

VI. Egg discoloration

What is the mechanism of egg discoloration by cottonseed meal?

Are there other compounds besides gossypol involved in this problem?

What progress is being made on methods for producing meals which are satisfactory for laying hens?

VII. Dermatitis in swine

What new information do we have on the cause of dermatitis in swine?

VIII. Cottonseed fatty acids

What problems are involved in the use of cottonseed fatty acids in farm feeds?

First on the program was Leo V. Curtin followed by C. L. Morgan, H. W. Bruins, Edward L. Stephenson, H. D. Wallace, Arthur A. Camp, C. E. Singletary and D. F. Rentshler, who discussed Item No. III., Use of cottonseed meal and cottonseed meal-soybean meal mixtures in poultry and swine rations. Opportunity was given after each presentation for questions and comments on the subject matter presented.

Attendance list with addresses is appended to this report.

Afternoon Session: January 24; A. M. Altschul, Presiding

The subject for discussion was Item I., Toxicity. This was opened by Carl Lyman, followed by Edward Eagle, C. R. Grau, K. T. Holley, Edward L. Stephenson, C. B. Singletary, John R. Lowry, J. E. Corbin, Burt W. Heywang, J. R. Couch and N. R. Ellis.

Item II. Chemical and biological methods of evaluation, was discussed by T. H. Hopper, Carl Lyman, Edith A. Jensen, Edward Eagle, John R. Lowry, and C. R. Grau.

Morning Session: January 25; A. M. Altschul, Presiding

Discussion of Item II. was continued by Godfrey E. Mann, T. H. Hopper and W. M. Connors.

Item IV. New approaches to processing which may result in the production of superior quality products, was discussed by W. H. King, F. H. Thurber, N. B. Knoepfler, E. A. Gastrock and C. R. Grau.

Item V. Bound gossypol, was discussed by Leah C. Berardi.

Robert John Evans and C. R. Grau then discussed Item VI. Egg discoloration.

Afternoon Session: January 25: A. L. Ward, Presiding

Introduction to committee reports taken from comments by A. M. Altschul at first session, January 24.

Altschul

I might give you a little background to this meeting. The last meeting of this kind was held in November 1953. That was a public meeting. By a public meeting, I mean one that has been announced in advance in the press and in the trade journals. The resolutions that were adopted at that meeting were widely publicized and I think had a profound influence on the handling of cottonseed meal and its marketing. The question was raised about three or four months ago by Mr. Ward as to whether it would be advisable for us to meet again. After some discussion, it was decided that the next meeting should not be a public meeting. Instead, only a limited group of people who had their hands in the field, were very busy working at it, and could exchange information should be invited. At a meeting held at College Station in November of last year between Mr. Harper, Dr. Lyman and myself we made plans for this meeting and drew up an invitation list. We felt that the group ought to be limited in size so that we could get some work done. I am very happy to say that very few invitations were turned down. We also invited a few people who had not been in the cottonseed industry, but who had very interesting approaches to methods of measuring nutritive value. We invited Dr. Evans because he has done some interesting work on egg yolk discoloration.

There are two purposes to this meeting. One is to plain exchange information; everyone can talk informally about what he is doing, what he has found, where he thinks he is going, and what he thinks ought to be done. That would in itself justify the meeting. But it is a good idea to try to see if we can also arrive at a consensus, wherever possible. We tried that at the last meeting, in November 1953, and we were able to adopt so-called resolutions, which really were a consensus of where we stood on the cottonseed meal problem. It is a year and a half later and it is entirely possible that we ought to be able to arrive at some sort of group opinion of where we stand.

We would like to propose for your discussion and approval, rules for the meeting. We would like to suggest that this be a complete off-the-record meeting. Anything that anybody says cannot be made public without the consent of the person who makes those statements. This will ease the discussion and will allow people to say perhaps a number of things that they wouldn't want to say otherwise.

We would now like to appoint a committee on each of the eight conference subjects listed in the program. We thought we would appoint several people to listen very carefully to each of those subjects, not necessarily to take notes, or to take minutes, but to try to get the feeling of the opinion of the group. At the last session of the meeting, they would present a very brief report of their opinion on the status of that particular subject. That would be our means for attempting to arrive at a consensus.

The following appointments to the committees were made.

Toxicity -

Dr. Heidebrecht, Chairman
Dr. Carroll
Mr. Mann
Dr. Grau

Chemical and Biological Methods of Evaluation-

Dr. Corbin, Chairman
Mr. Ellis
Dr. Evans
Dr. Morgan
Dr. Stephenson

Use of Cottonseed Meal and Cottonseed Meal-Soybean-Oil-Meal Mixtures -

Dr. Watts, Chairman
Mr. Rentschler
Dr. Couch

New Approaches to Processing -

Dr. Fincher, Chairman
Dr. Eagle
Dr. Thurber
Mr. Gastrock
Mr. Cecil

Bound Gossypol -

Dr. Kuiken, Chairman
Dr. Barriek
Dr. Lowry
Dr. Connors

Egg Discoloration -

Dr. Bruins, Chairman
Dr. Curtin
Dr. Stephenson
Mr. King

Dermatitis Question -

Dr. Curtin, Chairman
Dr. Wallis
Dr. Stephenson

Cottonseed Fatty Acids -

Dr. Couch, Chairman
Mr. Dollear
Dr. Camp

Ward Dr. Altschul, have you any suggestions about procedure after having received these reports from the committee?

Altschul Yes. I do not see any point in voting on the reports. I would suggest that the committee reports and the discussion at this session be put out as soon as possible and circulated to those in attendance. Anyone who has a comment to make, will do so. When we send out the final reports, we will send out the committee suggestions plus any comments that anyone wants to make on that report.

Stephenson Are these committee reports going to be released to industry?

Ward No.

Stephenson Then, in other words, any recommendations we make will be on our own. This will not be released to industry anyway.

Ward It is released to those present, then it is up to them what they want to do with it.

Stephenson Then can anyone present release any part of that to industry that they wish to?

Ward Not as this committee's recommendation but as his own recommendation.

Report of Committee on Toxicity by Heidebrecht, Chairman.

Heidebrecht The poultry data indicated wide differences in toxicity with respect to free gossypol levels. It is the contention of Heywang that the chicken can tolerate a level of .016% of free gossypol in its diet without depression of growth. Couch, on the other hand, finds a tolerance of .04% free gossypol or higher.

For swine - according to Stephenson- a ration containing .0045% free gossypol can be fed without symptoms of toxicity or growth depression. Some evidence of toxicity was

obtained with certain cross-bred swine when the ration contained .0066% free gossypol. It was pointed out by Wallace that pig size has an influence on tolerance to free gossypol. Levels of 0.009% free gossypol were found by Ellis to be without adverse effects. Symptoms were observed at levels at or above .012% in two experiments, whereas in an earlier experiment even 0.024% produced no observable effect. Holley found that when a screw-press meal was used, the diet could contain 0.006% free gossypol. When a laboratory-prepared meal was fed in an amount contributing 0.012% to the diet, toxicity was noted.

Eagle's work indicates that in rats the discrepancy between determined free gossypol and meal performance is particularly serious.

Breed and strain differences in resistance to toxic effects of gossypol were noted with both chicks and swine.

On the basis of the data presented, the committee recommends further work on the problem of toxicity and biological availability of gossypol. This committee is of the opinion that free gossypol in cottonseed meal remains as a major toxicity problem.

Discussion Heidebrecht

The committee discussed at length the discrepancy between the data presented by Heywang and Couch. The question arose as to whether or not there was a possibility of destruction of the gossypol in the pigment glands in the case of Couch's and Lyman's work - whether this might be the cause for the discrepancy.

I wonder whether Couch or Dr. Lyman would care to comment.

Lyman The glands were analyzed before they were prepared.

Heidebrecht Were the diets analyzed after they were prepared?

Lyman Not after they were made, no. We presume that being protected in the glands they would be safe.

Heidebrecht What affect would the salts have on the stability?

Lyman I don't know.

Heidebrecht The committee just wondered if that might be in the picture.

- Couch I think that that might be one of the factors and the whole thing is that I don't think you can compare the two toxicity levels. We were using entirely different rations, ingredients and everything else. We did mix our feed once a week and we assumed, as Carl says, that the gossypol in the glands would remain in the glands until liberated in the gut. When you mix a feed once a week, the destruction there would be at a minimum, I think. We didn't test that.
- Grau We found that when we added isolated gossypol (not gossypol in pigment glands) to a purified diet - there was only about half as much gossypol available for egg incorporation as when a natural diet was used. There seemed to be some materials there such as glucose, or minerals, which caused a lot of gossypol destruction.
- Couch There is not question about that Dick, but in this case, when you have the gossypol in the pigment gland the pigment gland has to be broken.
- Grau Yes, I agree.
- Couch That is one of the reasons why we used pigment glands rather than free gossypol.
- Curtin Is there a possibility that this purified ration with a high level of cerelese might be hygroscopic?
- Lyman Kept in sealed cans, I don't think so.
- Holley What evidence is there that the glands break in the intestinal tract?
- Couch You get toxicity.
- Holley No glands have been found in the feces?
- Lyman You are thinking that maybe only part of it was available.
- Holley You always have some refractory glands that don't break for some reason or other, I think.
- Lyman Well, I think Russ wouldn't mind if I tell you an additional experiment is on the schedule already in which we have high gossypol with the glands and with hexane extracted raw meats or raw meats themselves. Now those are direct comparisons.
- Couch Well, there is another thing too, in answer to Mr. Holley's question. We found in a test that I showed yesterday that we got the same toxicity with the glands as we did with free

gossypol, even when we fed it in capsules, in which we would assume that it was stable because we weighed the capsules daily and then capsuled the chickens. I think that would answer that question to a certain extent. We got the same toxicity levels.

Eagle

Some earlier work has shown that in experiments in which rats were given pure gossypol and cottonseed pigment glands of known gossypol content by stomach tube cottonseed pigment glands were found to be much more toxic than pure gossypol.

Was any mention made in the committee report (I came in late) of gossypol levels?

Heidebrecht

Yes, in the total diet.

Stephenson

He said that mine showed that cottonseed could be fed. It was fed, but whether that could be done to all strains or not, I would doubt that my data showed anything like that.

Ward

Just change the wording of that report that it did show in his experiment.

Report of Committee on Chemical and Biological Methods of Evaluation by Corbin, Chairman.

Others on this committee included Dr. Evans, Mr. Ellis, Dr. Stephenson and Dr. Morgan.

Corbin

Since we are in the initial phases of evaluation, this is rather difficult. Chemical and biological methods for nutritive evaluation show correlation with varying degrees of precision. However, as yet we do not have a single selective test that will provide an exact index to determine cottonseed meal response in practical rations.

Most of the data presented has indicated that nitrogen solubility in 0.2N NaOH, free gossypol, and bound gossypol can be used as indicators of general nutritive value for poultry and swine. Although these tests are not conclusive they should be retained until superior methods are developed.

Additional exploratory investigations should be undertaken on chemical, physical, and bio-chemical approaches for the evaluation of cottonseed meals. These should be correlated with the species with which the meal will actually be fed and, at least initially, values and results obtained with one species should not be indiscriminately applied to other species.

A reliable, rapid and duplicable method for the determination of nutritive value of cottonseed meal would greatly increase the use of cottonseed meal in commercial feeds. The feed industry is generally optimistic about the future use of cottonseed meal.

Discussion

Eagle Did you say nutritive value of cottonseed meal or nutritive value of protein of cottonseed meal?

Corbin Nutritive value of cottonseed meal.

Eagle Would you read that please.

Corbin A reliable, rapid and duplicable method for the determination of the nutritive value of cottonseed meal will greatly increase the use of cottonseed meal in commercial feeds.

Eagle I have a question. Is that statement correct? The nitrogen solubility method, for what it is worth, is supposed to indicate protein quality of cottonseed meal - not the nutritive value of cottonseed meal, but the nutritive value of the protein of cottonseed meal. Nutritive value of cottonseed meal means the overall food value, everything in toto being considered (protein, fat, carbohydrate, vitamins, minerals, unknowns, etc.). But nutritive value of the protein of cottonseed meal refers primarily to the quality of the protein in the cottonseed meal.

Corbin Mr. Eagle, in order to clarify that, we realize that our definition is rather comprehensive; however, in order to avoid such discussions as you bring up at this particular time, that is the reason we made it so comprehensive, and that would definitely include the protein evaluation.

Report of Committee on Use of Cottonseed Meal and Cottonseed Meal-Soybean-Oil-Meal Mixtures by Dr. Burl Watts, Chairman.

Watts As this committee understood their mission they were to determine the pulse rate in relation to this problem and I believe it was somewhat erratic.

Ward Burl, just for the information of the group, give us the rest of your committee there too.

Watts Dr. Couch and Mr. Rentshler.

Our suggestions, and we are making them as suggestions, relate to the resolution that was adopted at the previous meeting which I might read again so that we'll have a basis

to start on. "The results presented thus far indicate that chick and broiler rations containing cottonseed meal and soybean meal in equal proportions on a nitrogen basis are equal or superior to rations based on either cottonseed meal or soybean meal alone when the cottonseed meal used has .04% or less free gossypol and 75% or more nitrogen solubility in .02N NaOH." (The next paragraph was skipped.)

"Preliminary indications in so far as free gossypol is concerned were that cottonseed meal having .04% or less free gossypol can be fed in balanced diets for chicks, broilers and swine."

On the basis of that and what has been presented and the suggestions made to the committee by various individuals we make the following suggestions regarding this resolution that the 50-50 mixture part of the resolution appears to be on rather safe ground as it applies to poultry.

The .04% free gossypol also appears to be on safe ground since in summarizing the various papers that were given all of the meals contained around .04% or less free gossypol. The committee also suggests the possibility that the nitrogen solubility figure might be revised downward to some figure. Seventy percent was suggested, which we understand from Mr. Hopper would have a plus or minus 2% accuracy. An expanded study on the nitrogen solubility of the expeller and hydraulic meals, might also be made. Another suggestion was made that we might want to standardize these resolutions on the basis of a 44% protein cottonseed meal for two reasons: to be able to replace pound for pound without reduction in protein content of the ration and, two, fiber appears to be an important factor in mixtures, particularly those exceeding the 50-50 mixtures, in that growth was not affected as greatly as was efficiency.

Another suggestion was made to the committee that something might be put in the resolution regarding bound gossypol contents not exceeding .85%.

Another suggestion, turkeys might be included in this resolution. As far as I'm concerned, the mention of poultry includes turkeys, but it could be spelled out, and, there, a level of 10% cottonseed meal in the ration would be the maximum replacement.

As far as swine is concerned, the studies presented were not as extensive as were the chick studies, subject to some confounding features in some cases. The data presented for swine did not appear to be quite as good as for poultry; and, that the low gossypol meals are safe to use with swine.

Discussion

- Curtin Is there any specific reason for spelling out percentage of cottonseed meal in turkey rations in contrast to replacement of soybean meal as we've done with poultry?
- Ward Couch, do you want to answer that?
- Couch We find that these manufacturers are, they always want to be, on the safe side. They are using now, have used in the past season, I think, up to around 5%. The data presented here at this meeting as well as some of the other data which I've seen, points to the fact they could use up to 10% without running into a lysine deficiency. And I think something spelled out in here would help the industry to the standpoint of increasing the usage of cottonseed meal in turkey feeds. If the feed manufacturer thinks he is liable to run into white feathers in his turkeys, he is going to stay away from it. That is the reason for our reasoning.
- Bruins Do you think the 10% level is high enough? In our report we fed at least 12%.
- Couch Based on the data I have seen I think you could go up to 12-1/2%, but if you take all the cottonseed meal across the board, I think 10% would be a safer figure.
- Watts It depends on what else is in the ration.
- Couch Well, sure, that is quite true, but in this case taking the normal, mixed, formulated turkey feed, which would contain the various things that you and I are familiar with, I think 10% would be quite a safe level; whereas, I think, in some instances a man might run into trouble with 12%. I'm not trying to run down anything you have presented or anyone else because I feel that I would be safe, I think, in using up to 12-1/2%. On the other hand, if we are likely to run into trouble I think we are on much safer ground to just go a little below that 10%, I feel perfectly safe in sticking to that.
- Grau I think perhaps one point of disagreement here is the age of the bird. Now, I think with a starting turkey ration it is very hard to formulate a mash containing much cottonseed meal. But after eight weeks, when the protein intake is high, you can go to 25% without any difficulties because the lysine requirement goes down. Perhaps a distinction might be made between starting turkey rations and growing turkey rations.

Couch

Well, in this case I've fed 10% starting turkeys with good results. No trouble at all. I mean as long as you make up a standard turkey feed. In this case we are using other things that would go into a normal turkey feed and I know you are familiar with all of those; but, if you take and put in a little animal protein and so forth and so on down the line, the 10% can go in starter feed and we didn't run into any white feathers. I know that it is borderline on lysine but I have no hesitancy in recommending that; and, as a matter of fact, we have representatives from one or two feed companies that have been using cottonseed meal, pre-press solvent, nitrogen solubility and so forth that approximates these levels, with good success and they used it at least a year or two before we ever came out with any of these recommendations.

Watts

I am very apologetic here, for I overlooked one point which the committee thought very important. The rations fed to chicks in the studies presented here contained from 2-1/2% of animal products (or products of animal origin) and up. The committee thought that this was a very important point in connection with this replacement of cottonseed. I didn't mention that point when I read the report and we did consider that very important.

Eagle

I would like to point out that certain cottonseed meals with very low free gossypol content, lower than .04%, have demonstrated toxicity. Did you report that, Holley? That cottonseed meals of free gossypol content lower than .04% can be toxic?

Holley

The meal was around .06%.

Eagle

Well, there was a difference. We have also had experience with a meal in our laboratory at .03% free gossypol which was lethal to rats. Dr. Stephenson reported a meal containing less than 0.04% free gossypol which was toxic to swine.

To be consistent then for the record, and in keeping with a motion I made at the last meeting of the Research Committee of the NCPA, that Rule 263, which defines the 0.04% level, be rescinded. I object specifically to including any reference to .04% free gossypol as a criterion of safety.

Ward

In other words, in order to carry your point with the NCPA Committee, you want this group to make a recommendation that you can use?

Eagle If my understanding that the minutes of this meeting will be transmitted to the research committee of the NCPA is correct, they should be apprised of this objection.

Ward Mr. Eagle can make his objection and include it in this committee's report. Your objection can be appended thereto.

(A statement was submitted on February 23, 1955 by Dr. Eagle for inclusion in the proceedings. This statement is appended to the revised report of Committee III.)

Couch One other point I'd like to clear up. Did he (Watts) mention bound gossypol or total gossypol?

Watts We also made the suggestion that you might want to include a level of total gossypol in the definition of the meal, and a suggestion was made that a level of .85% be set as a maximum total gossypol.

Altschul Do you have any evidence of that?

Watts That was a suggestion that was made to the committee. I am passing it on to this group to discuss. These are all made in that light.

Altschul I'd be curious to get the basis for that suggestion.

Ward Do you think that this conference brought out sufficient evidence to justify you to put that in, Burl?

Watts I made the suggestion for discussion, which I understood this was to be. We are not making it as a recommendation.

Ward No, I know that Burl, but the point is your committee was to take the evidence presented here and sift it.

Watts My report is strictly suggestions for discussion. We merely misunderstood, at least I did, our position. In the light of your comments, we ask for the privilege of presenting a revised report.

Lyman May I comment? I am not sure where this suggestion came from, but I suspect I know, and that is the report on the evaluation of pre-pressed solvent meals where the meals as a whole with high total gossypol were not the meals which were in the higher group of nutritive value. I suspect that is where it came from. Now that observation was very useful in guiding further work. I would not suggest that it be retained as a part of the conclusions to be drawn.

Curtin

I would like to mention a report that wasn't reviewed here in this session - a report from Mississippi State College on turkey work, reported at the last Poultry Science meeting in which the cottonseed meal they fed satisfactorily replaced over 50% of soybean oil meal in turkey starter rations.

Revised Report of Committee III.

Watts

This committee would like to present it's revised report. For poultry, (1) Mixtures of equal parts of cottonseed meal protein and soybean meal protein appear to be satisfactory for poultry feeding. (2) Cottonseed meals of .04% free gossypol appear to be safe for use in poultry feeding. (3) Possibly nitrogen solubility figures might be revised downward to 70% which figure has an accuracy of plus or minus 2% according to Mr. Hopper's report. (4) An important consideration in the use of cottonseed meals and cottonseed meal mixtures in poultry ration is the use of 2.5% or more of products of animal origin in the ration.

For swine, the committee points out that the swine work on this subject presented here was not as extensive as that with poultry. Therefore, the following statements are made.

(1) Replacement of soybean meal by cottonseed meal in swine rations may be more critical than with poultry. (2) Meals of .04% free gossypol can be safely used in swine rations.

Now the suggestions, do we want those?

Ward

Yes, the suggestions of the committee.

Watts

The committee merely suggests:

1. That a standard of 44% protein for cottonseed meals be established for the following reasons:
 - a. Replacement may be made on a pound for pound basis without reduction of protein in the ration.
 - b. Fiber appears to affect results of tests when replacement of over 50% of the soybean meal by cottonseed meal since growth was not affected as greatly as feed efficiency.
2. That turkeys be added to the resolution with a limitation of 10% of cottonseed meal in their ration.
3. Further and expanded studies should be made on nitrogen solubility in relation to hydraulic and expeller processed cottonseed meals.

STATEMENT RELATING TO THE REPORT OF THE COMMITTEE ON THE USE OF COTTONSEED MEAL AND COTTONSEED MEAL -SOYBEAN OIL MEAL-MIXTURES IN POULTRY AND SWINE RATIONS

In accordance with the suggestion made by Mr. Ward, I wish to call attention to the following data and discussions which in our opinion do not conform with the recommendations of the above named committee:

- a. The following publications have questioned the reliability of gossypol analyses as true indicators of toxicity:
 - (1) Gallup, Ind. Eng. Chem. 20: 59-63 (1938).
 - (2) Boatner, Altschul et al., Poultry Sci. 27: 315-28 (1948).
 - (3) Eagle, Castillon, Hall and Boatner, Arch. Biochem. 18:271-7 (1948).
 - (4) Eagle, Hall, Castillon & Miller, J. Am. Oil Chem. Soc. 27: 300-3 (1950).
 - (5) Eagle and Bialek, Food Research 15: 232-6 (1950).
 - (6) Ambrose and Robbins, J. Nutrition 43: 357-70 (1951).
 - (7) Eagle, Bialek, Davies & Bremer, J. Am. Oil Chem. Soc. 31: 121-4 (1954).
- b. The following data presented at the Conference showed lack of correlation between gossypol content and toxicity of cottonseed meal:
 - (1) The paper by Eagle et al. listed a total of 57 cottonseed meals which when toxicologically evaluated in the rat at the 67% level in the diet failed to show a correlation between their toxicity and their free, total or combined gossypol content.
 - (2) The report by Dr. Holley that a cottonseed meal containing 0.06% free gossypol was toxic to the hog when incorporated at a level contributing only 0.012% free gossypol in the ration.
 - (3) The report by Dr. Stephenson that a cottonseed meal containing less than 0.04% free gossypol was toxic to swine.
 - (4) Wide differences in toxicity with respect to free gossypol levels in the diets of poultry were presented at the Conference--Heywang reported that the chicken can tolerate a level of 0.016% free gossypol in the diet; Couch finds the tolerance for free gossypol to be 0.04% or higher.
- c. The data presented by Eagle at the Conference on nitrogen solubility vs. protein quality of cottonseed meal showed poor correlation between biologically evaluated protein quality of cottonseed meals in the rat and the nitrogen solubility in 0.02 N sodium hydroxide, and questioned this chemical test as an indicator for protein quality of cottonseed meals.

On the basis of the foregoing it is my opinion that a level of 0.04% free gossypol in cottonseed meal has not been scientifically substantiated as the demarcation line between toxic and non-toxic cottonseed meal for feeding chicks, broilers and swine. Furthermore, the available scientific data do not justify any nitrogen solubility figure as a threshold criterion for protein quality of cottonseed meal.

Report of Committee on New Approaches to Processing by Fincher, Chairman.

Others on this committee included E. Eagle, F. H. Thurber and E. A. Gastrock.

Fincher The aim of the processors is to produce cottonseed meal which will be universally acceptable to feeders. To do this the meal must eventually be satisfactory for feeding to all animals, even including laying hens. To accomplish this, rapid tests for evaluation of toxicity and protein quality of meal and for testing oil quality are essential.

The important variables are seed quality when processed, meats preparation, type of process, cooking conditions where applicable, extraction conditions and post-treatments. The immediate research objectives are concerned with cooking conditions which include, moisture, temperature, time, degree of agitation, and chemical additives.

As a result of research and development to date, some cottonseed meal has moved into mixed feeds used for swine and broiler rations - thus accomplishing on a limited basis the objective set out at the beginning.

Report of Committee on Bound Gossypol by Dr. Kuiken, Chairman.

The members of the Committee were Lowry, Connors, and Barrick.

Kuiken We feel that the evidence presented would indicate that there are definitely a variety of forms of bound gossypol and that these different forms may have different physiological effects. The type of bond that you get would be influenced by the chemical characteristics of the medium at the time that you caused this bonding to occur and also by certain physical conditions that would prevail.

The most concrete evidence of value relative to interpreting bound gossypol is that presented by Lyman and Couch which we feel indicates very clearly that in the processing of meal there is a bonding between gossypol and lysine. The evidence in support of this to the effect that for different degrees of bound gossypol content you get a correlation in response to supplemental lysine. The higher



the bound gossypol content the more response to supplemental lysine. Also the account of Lyman where he selected a meal, commercial meal, of high bound gossypol content and was able to reduce the bound gossypol content by addition of, or treatment with aniline. This meal showed an increase in nutritive quality, an increase in lysine availability, and also an increase in alkali solubility. We think this latter point on increase in alkali solubility is of particular importance because it suggests to us that gossypol is functioning as a cross-linking agent and in effect increasing molecular size and thereby reducing solubility. The concept of this nature is also supported by evidence not presented here but developed in discussion with Godfrey Mann relative to solubility in urea. They (Lyman & Couch) also had very interesting data with regard to feeding a gossypol-lysine compound prepared in the laboratory which demonstrated that the lysine availability from this compound in a rat feeding test was zero. We feel very conclusively that a lysine-gossypol addition-situation has been confirmed that this does definitely affect nutritive quality.

The gossypol availability concept which Grau introduces here is of particular interest suggesting a form of bound gossypol which may be reversed by acetone extraction. We think in this case it is of particular interest to take meals prepared by water treatments such as Holley described and subject them to the apparent gossypol analysis suggested by Grau and see what can be developed from those data.

With regard to the report of Mrs. Beradi we were not able to interpret the experiment. We suggest that the factor of immediate critical importance is to determine what can be done to interpret why the bacteria do not grow on these materials. However, we feel that this is an important new approach to the problem and that it should be pursued very vigorously.

Report of Committee on Egg Discoloration by Bruins, Chairman.

The members of this committee were Mr. King, Dr. Curtin, and Dr. Stephenson.

Bruins

The problem of egg yolk discoloration, perhaps we should say egg discoloration, caused by feeding cottonseed products to hens may be divided into two parts: (1) The mottled, reddish to olive color of the yolk, presumably caused by gossypol. (2) The pink white, salmon yolk caused by an unidentified fat soluble material. This is usually associated with enlargement of the yolk.

The apparent discrepancies noted in the past between egg yolk discoloration and free gossypol content might be explained by differences in biologically available gossypol as determined by the method of Grau (Agricultural and Food Chemistry, Vol. II, P. 982). One form in which gossypol appears in the egg yolk is gossypol-cephalin complex, the quantity of which is not an accurate index of the discoloration of the egg on storage. The gossypol-cephalin content of the egg yolk is correlated with the development of egg yolk discoloration when fresh eggs are broken in an atmosphere of ammonia.

Evidence presented by Dr. Evans indicates that the pink white discoloration is associated with a transfer of protein from the white to the yolk with an enlargement of the yolk. The pink white is accompanied by vitelline membrane changes.

Future work on the following phases of this problem are suggested:

- (1) A maximum tolerance for egg gossypol compounds should be studied. This figure would be the highest egg level at which no discoloration on storage would occur.
- (2) After such a maximum figure has been obtained the amounts of available gossypol in various types of cottonseed meals should be determined.
- (3) From the information obtained in above 1 and 2, the quantity of various cottonseed meals which can be used with safety in the diets of laying hens. can be calculated.
- (4) Further work is necessary to determine the effect of processing variables on the content of available gossypol in the meal.
- (5) Further research is necessary in the mechanisms of color development in both pink whites and olive yolks.

Discussion

Heywang

Ward, can I hear that part again before you refer to Dick Grau.

Bruins

We say the apparent discrepancies noted in the past between egg yolk discoloration and free gossypol content might be explained by differences in biologically available gossypol as determined by the method of Grau.

Heywang I didn't hear your "might". I just wanted to say among other possible explanations according to the present methods for the determination of free gossypol is the one offered by Dr. Grau, which is quite different.

Bruins Yes.

Report of Committee on Dermatitis in Swine by Curtin, Chairman

The other members of the committee were Dr. Stephenson and Dr. Wallace.

Curtin During the last two years the condition of dermatitis in swine has taken on even greater importance. Similar dermatitis has been observed in swine fed a number of other types of rations in addition to cottonseed meal rations. For some unidentified reason, certain colors of hogs are more susceptible than others.

Preliminary observations, obtained by the Buckeye Cotton Oil Company, indicate that supplemental zinc will prevent the occurrence of dermatitis in pigs fed a corn-degossypolized-cottonseed-meal ration.

Discussion

Altschul Would there be any possibility that a deficiency in cystine could be the cause of that?

Curtin That has been suggested and I don't know. It is possible. A cystine deficiency, I think, has been reported.

Altschul I might call attention to the availability of feather meal which if processed properly ought to be pretty high in cystine. The people at the Western Regional Research Laboratory would be very happy to supply samples of chicken feather meal, an especially processed meal, that might be processed in such a way as to retain cystine and not knock it out in the processing.

Curtin That is one thing we wanted to try.

Altschul Anyone who wants to get some, if you will let me know the amount, I'll be glad to transmit that information to Dr. Leinweaver at the Western Laboratory.

Report of the Committee on The Cottonseed Fatty Acids by Couch, Chairman.

Couch I worked with the Chairman of another committee so we didn't have a chance to do much, but I do have all the data in front of me which would have been presented, I think, had we had an opportunity. We came up with the following and you might consider it a report.

The first point is the level of hydrolyzed vegetable fats which can be used in broiler feeds. Data from three laboratories show that 6% hydrolyzed vegetable fats, 85% total fatty acids or higher, may be used in broiler feeds with good results.

Particular attention should be directed toward the addition of an antioxidant to these hydrolyzed vegetable fats. Most of the work that has been done, and I can say all the work that has been done at our laboratories has been carried out with the hydrolyzed vegetable fat that Tenox added as the antioxidant.

We ran into the rather interesting - this is not part of the report - this is an addendum - phenomenon, namely that when we add the hydrolyzed vegetable fat at a high level, up to 10%, we found a decided lowering of the Vitamin A storage in the liver. In this case, we were using a stabilized Vitamin A which has been giving good results under the conditions of our experiments. We feel as though in this case - and again this is off the record but it might be considered as a comment - that possibly DPPD might prevent this particular phenomenon because we have certain information, available from other laboratories, to the effect that we think DPPD protects the Vitamin A in the digestive tract. Even though the antioxidant might be added to protect the changes in the hydrolyzed vegetable fats while the material is in the container, barrel, or whatnot, it also possibly should protect after the fat is added to the feed. We need something possibly to protect the fat after it reaches the digestive tract of chickens. I think more work is indicated along this line, to determine just what is occurring there and to eliminate if possible this apparent destruction of Vitamin A.

Discussion

Ward That is when we use the large percent.

Couch Well, I don't know what it would do on a small percent. We used 10%.

Ward Up to 10. Of course, practically, we know that mills that are adding it now are adding it at 1/2 to 1-1/2%.

Couch Well, that is true in meals, but what we are thinking of here, talking to Dr. Curtin and Camp, we had in mind that we might use these hydrolyzed vegetable fats in feeds. Am I right on that Leo? In place of the animal fats. Now we have quite a problem in the feed industry at the present time. We went along and determined that we should add animal fats to

dress up the feed and improve feed efficiency a bit. Well, immediately, the price of animal fats went out of sight, and we think in this case that we might help use up, if you please, some of this excess of hydrolyzed vegetable fats which is available and which could be added to feeds at a level of 2-1/2 to 5%. That is all I have in mind in this report. I am not thinking here in terms of adding it to the cottonseed meal as is being done by a number of mills. I am thinking of taking the cottonseed hydrolyzed vegetable fats and adding it directly to a mixed feed.

Ward Any questions? Leo.

Curtin Russell, is it not right that DPPD has only been approved for use in poultry feeds?

Couch That is correct. DPPD has only been approved for use in poultry feeds. I think that it will be approved for use in feed for the large animals, but --

Ward Tell us what DPPD is.

Couch N,N^1 -Diphenyl-p-phenylenediamine

Curtin I realize, of course, that there are vast differences in acidulated soap stocks and we did not use the levels that you have used at Texas A & M, 6% is as high as we have fed. We have never encountered any difficulty with stability as measured by growth rate and development of rancidity using odor tests. We have tried the A. O. M. stability test which is used on animal fats and it is apparently not applicable to acidulated soap stock. We have tried another oxygen absorption stability test which measures the oxygen used up in a given period of time, and under those conditions the acidulated soap stock we used was more stable than so-called stabilized animal fat. That would be animal fats stabilized by the addition of Tenox 2 at the rate of one pound per ton.

Couch Well, in this case, I'd like to comment further that in our tests we ran 2-1/2, 5, 7-1/2, and 10. We got good results up to 5 and we got a little growth depression at 7-1/2 to 10. And then we have an assay procedure for determining the stability of Vitamin A products by using liver storage tests and in this case we decided to determine whether the soap stock might have bad effects or good effects, or whatnot, so we simply put it through this assay and determined that we actually got in the liver 740 units of vitamin A per liver without the soap stock and we only got 341 when we added so we got a definite decrease there.

Ward I would like to make a comment here. There may be some men here who don't know why our cottonoil processors are adding this hydrolyzed vegetable fats. When we got into solvent extraction we were able to produce a meal that was an excellent meal but it was very fine, just like a face powder, and we also ran into the difficulty of making a pellet that would not be too hard or too brittle. So, our own Educational Service asked Carl Lyman if he could look into it. I think, as I remember, he is already wondering about that problem. That is why the hydrolyzed vegetable fats have been added to meals from solvent mills, in order to put the powdery meal into more acceptable mechanical condition. The same way about the pellets. And Leo, do you want to add anything as to the reason why you did?

Curtin No, that's it.

Ward That is the whole thing.

Curtin To improve the acceptability of the meal.

Ward Acceptability to the trade. Dr. Barrick.

Barrick I might just point out that we have used these acidulated soap stocks in rations for swine added at the level of 5 to 10% in comparison with other sources of fat and found it to be just as efficiently utilized for growth and just as efficient in feed utilization as other sources of fat. However, we do get a softening effect on the carcass, increase in linoleic acid content in the carcass.

Heidebrecht Couch, in the experiment you referred to, did you use distilled free fatty acids?

Couch Acidulated soap stock.

Holley I wanted to ask you if there are any monoglycerides in those products?

Curtin There quite possibly are.

Couch Primarily free fatty acids with some tri-glycerides. It would be reasonable to assume that you have a few di- and mono-glycerides.

Lyman I believe I will make this comment. I don't believe we know the previous history of this batch of acidulated soap stocks. Do we, Russell? Because this material has not been of very much economic value, that may have been a sample that

has been around for quite a while. I think we should be cautious in concluding that that would be what would happen if we had a freshly prepared, carefully stored product. It might still do it, but perhaps it wouldn't. Perhaps the characteristics might be more like the one Curtin has described. Quite stable possibly if properly prepared and not kept too long.

Morgan I want to ask Russell a question. Was the depression in Vitamin A storage noticeable at all levels of feeding acidulated soap stock?

Couch Those levels there, 10%, did it. We tested those others on growth only.

Morgan I see, you didn't check that.

Couch We decided to check this. Now in this case, I would like to point out again, though in line with what Carl is talking about there, that I think the change may be occurring in the tract and not necessarily in the feed. We have some evidence from our study that points to that fact. That has nothing to do with acidulated soap stock.

Ward Any other comments? I will now call upon Mr. Carlon Harper for a report.

Harper This committee was appointed this morning, you'll remember in regard to setting a date for the next meeting. On this committee were Carl Lyman, Heidebrecht, Dr. Altschul, Dick Grau, Dr. Curtin and Mr. Ellis. In spite of the very easy job that this committee had, we feel that maybe we should call on you for a little bit of help. It was tentatively agreed that perhaps the next meeting should be held in November, 1956, or January, 1957. The point that we wanted some help on was whether or not you would rather have the meeting in the Fall, in November, or in January. There has been some suggestions that November is a rather crowded month for most of the research workers, The American Society of Animal Production meets at that time, and so on. With just that little bit of thought we would like to see a show of hands here of those who would prefer the meeting in November and then following that those that would prefer the meeting in January.

The majority were in favor of a January, 1957 meeting.

I think that most people have the understanding, of course, that if a meeting should be deemed to be necessary next January, (January 1956) well then, of course, that suggestion could be made.

- Altschul I wonder if people feel that in a year hence we might be in a position to call a public conference. You see, there has not been a public conference since November, 1953. This is a private conference, by invitation only. I think that every once in a while, we should have a public conference, and the invitations sent through the press so that anybody who wants to can attend. Then if there are any resolutions, they would have more meaning since anybody who was interested would be sure to be here.
- Curtin Presumably, since this is a private conference, so to speak, material presented since the last conference would be in order for presentation at the next conference. Is that right?
- Ward You mean material presented at this conference might be available for presentation at the public conference.
- Curtin Yes.
- Altschul If there were no more material available for presentation than what is available now, another conference next year wouldn't be warranted.
- Ward This committee has been appointed, they had a meeting, they've made a report and they've taken a vote. However, the committee is a committee from now until the next meeting is called, and in six months' time they may decide to call a meeting in January, 1956. That will be left up to that committee; they're not excused from any further responsibility until we do hold the next conference.
- Harper I would like to say this, that several on the committee, as well as others that we talked with, suggested that they felt that two years would be too long and that a meeting would be in order before then.
- Ward It is a little bit long, when you shove it on from November clear on into January, that gets into a 2 year proposition. We do not desire to have a meeting until we have some further data developed. There will be plenty time next July or August for this committee to correspond with each other and determine then or even later in October whether or not we should have a meeting next January. So if it meets with the approval of the group present, we will let that committee still stay on the job and determine when this next meeting is to be called. Whether it's January of 56 or January 1957.
- Ward I will now call upon Dr. Altschul for general comments.

Comments on Status of Measurement of Nutritive Value and of Toxicity of Cottonseed Meals:

Altschul

After having presided at the first three sessions of this conference and having refrained from participating in the discussions thus far, I thought that I would like to make a few comments on some of the matters that were brought out.

We have spent a considerable time during this conference discussing specifics, to such an extent that it seemed at times that we had lost sight of some basic principles. Evidence was presented at this meeting that the simple use of two measures, nitrogen solubility and free gossypol, does not provide for a clear cut evaluation of all possible cottonseed meals. Several of you have found inconsistencies in your data that do not fit in with the resolutions adopted at the last public conference held at this laboratory in November 1953. This is exactly the way it should be because these resolutions, as you will recall, called upon scientists to test the proposition that meals containing 0.04% or less free gossypol could be fed in unrestricted proportion in balanced diets for chicks, broilers, and swine. A similar situation existed with respect to 75% nitrogen solubility in 0.02 normal sodium hydroxide solution as being a measure of satisfactory protein quality.

We must now decide upon our reaction to these findings in terms of the type of work that will be done next. In order to decide this matter it is necessary to remind ourselves of the basic principles that have characterized this co-operative program.

I should like to discuss three principles that were involved as follows:

- (1) Methods for reducing the complexity of the problem
- (2) Characterization of nontoxic meals
- (3) Measurement of heat damage.

As is true for many other protein supplements, the usefulness of the material as a source of protein depends on the presence or absence of materials which interfere with its use by certain livestock, and secondly, on the value of the protein itself. This is much too complex a problem to handle all in one piece and therefore it becomes necessary

to try to reduce it to simpler terms so that individual aspects contributing to the value of the meal can be studied. For cottonseed meal this attempt took the form of finding ways and means of producing cottonseed meals that were nontoxic to nonruminants so that the separate effect of heat damage during processing could be studied, uncomplicated by toxicity considerations. Conversely, it should be possible to study toxicity uncomplicated by heat damage considerations by using fractions of the meal and by controlling the extent of heat damage in the experimental meals. Such an approach would make possible a beginning of the understanding of the factors that are involved in cottonseed meal nutrition.

You will remember that in some of the early experiments it was found that screwpress meals were relatively nontoxic to chicks. This procedure could be used to produce meals of varying heat damage to determine the effect of such an operation on nutritive value. The early experiments reported by Bird and associates in which the only variable used in producing the meal was the temperature of cooking prior to screwpressing, clearly indicated the effect of temperature of processing on the nutritive value of the meal. Later experiments with prepress solvent-extraction meals demonstrated as well the effect of heat during processing on the nutritive value of the meal. This is shown in the publication which recently appeared in the Journal of the American Oil Chemists Society giving the results of a number of nutrition investigations on commercial prepress meals. It seems to me that this principal remains sound and is the most uncomplicated way of trying to arrive at an understanding of the various factors that influence the nutritive value of cottonseed meal. An approach which neglects the several factors and which tries to measure toxicity under conditions which are complicated by heat damage or heat damage under conditions that are complicated by toxicity may be difficult of interpretation.

This first approach of dividing the problem into at least two phases, toxicity and heat damage leads us into the second matter, the gossypol situation. The first meals which have been studied as part of this program had free-gossypol contents of the order of magnitude of 0.04%, more or less. Questions were raised at the earlier nutritional conferences concerning the safe figure for free gossypol and the concensus arrived at the third meeting was 0.04%.

Let us examine the principal behind this statement. Gossypol is one of the major pigments in cottonseed. Pure gossypol is toxic to nonruminants. Therefore, it is considered

desirable for that segment of the cottonseed industry which wishes to extend its markets to the nonruminants feeds, to have as low a gossypol activity in the meal as possible. The low gossypol activity is interpreted to mean the lowest amount of the most chemically available gossypol. That is the basis of the free gossypol measurement because free gossypol measures the most chemically available gossypol, the acetone soluble gossypol. At the moment the figure that has been settled on is 0.04%.

It may be that gossypol is not the most toxic material in cottonseed and that the measurement of free gossypol and its relation to toxicity is only coincidental with the activity of something much more toxic. It may be that 0.04% free gossypol is not a universal figure for all meals or all nonruminants and will be subject to change as more experiments are conducted. It may be that there are other toxic materials in cottonseed, not as toxic as gossypol but contributing to the overall effect. All of these ideas are the subject of further experimentation. The results of these experiments will no doubt lead to modification in our thinking, but I doubt whether they can modify the general principle that it is desirable to remove as much of the gossypol activity in the seed as is possible. For no matter whatever else is said or done, it is known that gossypol is toxic and therefore it is desirable to remove it. Furthermore, the removal of gossypol requires the rupture of pigment glands which could have a desirable effect in removing other toxic materials as well.

A somewhat similar situation exists with respect to nitrogen solubility in dilute alkali. Dr. Lyman found a relationship between solubility in dilute alkali and nutritive value. In some very well defined heating experiments, we found a similar relationship at this laboratory. After a while, it was possible to obtain a consensus to the effect that about 75% solubility of nitrogen in dilute alkali was the breaking point between good and bad meals, that is, between meals of minimum and extensive heat damage. There seem now to be samples of good meals with nitrogen solubility less than 75%, perhaps some as low as 65%. Here again, it is best to remember the principle behind this measure. The first experiments conducted in this cooperative program demonstrated clearly that heat during processing had a very important effect on the nutritive value of the cottonseed meal for nonruminants. The chemical problem then was to develop some measure of heat. It is known that the solubility of certain proteins is affected by heat, and therefore it is only natural that the solubility of nitrogenous

material will somehow bear some relation to heat damage. Regardless of whether the breaking point at 75% will remain as the proper breaking point or whether it will be determined to be at another level, or even whether nitrogen solubility altogether will remain as a measure of nutritive value, it is still a sound principle to keep the heat damage at a minimum.

As a result of adherence to the three above-mentioned principles, the picture regarding cottonseed meal in relation to nonruminant feeds has become clarified. Considerable experimental work has been done on each of the variables involved in determining the usefulness of cottonseed meal for nonruminants. There has been a profound influence of this type of thinking upon the cottonseed meal industry. This influence has been reflected in the general trend towards reduced free gossypol in the meals and reduced heat damage. Much of this might have been due to natural causes. For example, a change over from hydraulic pressing to screw pressing and pre press-solvent extraction would result in a large reduction in the free gossypol content of the meal. But added to this has been the conscious effort of processors who want to reduce the gossypol and who want to maintain minimum heat damage, because they have begun to realize that this increases usefulness of, and markets for the meal.

In the 1954 season it is estimated that 150-250,000 tons of cottonseed meal found new markets in poultry and mixed feeds. As far as I know there were no complaints registered as the result of using cottonseed meal in these new markets. Thus the cottonseed industry has established itself in new fields by producing meals that are acceptable to poultry and swine feeders. It is entirely possible that the price differential between cottonseed meal and soybean meal will never again reach the differential that prevailed in 1954. But, the break has been made and it would seem that whenever economics are favorable, a considerable amount of cottonseed meal can continue to move into these new markets.

By far the greatest contribution made to the Cottonseed Program resulting from acceptance of certain tentative standards has been the stimulus to research, to check these standards and improve upon them. The many challenges that have been presented at this meeting would not have been possible if there weren't any standards against which to check experimental results. Certainly we are doing more research at this Laboratory on the methods of measuring nutritive value than ever before. As you have heard at this meeting, research is going on at this Laboratory on materials other than

gossypol that might have biological activity. You remember Dr. Grau's report on a biological test which seems to measure things other than are measured by free-gossypol. You will also recall that we are doing considerable work on the composition of the proteins in cottonseed meal in order to break down the solubility picture into its elements. We are also doing work on rates of hydrolysis of cottonseed meals as effected by heat damage. Both at this laboratory and at Texas A and M College is work going on on bound gossypol in order to determine its role in determining the nutritive value of cottonseed meal.

It might be worthwhile to spend a moment evaluating the prospects that will come out of this added research. I believe that the new physiological tests will contribute important information on the nature of physiologically active cottonseed materials, and may result in some modification or addition to the free gossypol measurements.

Recently I had the pleasure of discussing the question of heat damage with Dr. M. L. Anson who is a collaborator of this laboratory and advisor to us on this program. Some of Dr. Anson's comments and thoughts on this matter, I think, are rather pertinent to our thinking and planning. Damage to cottonseed meal by heat during processing may take on different forms, depending upon the type of processing and upon the extent of damage. It is therefore entirely possible that one single measurement will never be suitable for all types of processing or for all types of damage. It might be that the first step in screening meals would be to separate them roughly into two groups on the basis of a simple test, as for example the nitrogen solubility test and then use other more refined methods for differentiating between the various better meals.

The chances of arriving at a chemical measure of heat damage thus are improved as we reduce the number of processes involved and the range of heat damage measured. For any given single process, the problem is greatly simplified. Nitrogen solubility is fairly reliable as a measure of heat damage to pre-press solvent extraction meals (See paper of Lyman in J. A. O. C. S.). The same figures might not apply equally to screw-press meals. For pre-press meals, nitrogen solubility distinguishes between excessive heat damage and minimum heat damage, but is not equally successful in distinguishing between good and better meals, that is, between different levels of little heat damage.

While a universal measure of heat damage is the ultimate goal of research, the various milestones of progress in that direction are of themselves of practical value. A method for pre-press meals is very valuable to that particular segment of the industry as well as to the entire industry because it provides the chemical basis for control and evaluation which as an opening wedge for extended utilization.

Thus we must take a realistic approach to this problem. We must seek and use simple solutions first.

As our research continues, we can expand the range of variables and conditions which can be covered by chemical measures. All of this adds up to the fact that a more sophisticated approach will probably be required to reach a more nearly universal measure of heat damage.

All in all, I feel rather optimistic that there is a research program going on to try to answer these questions and that considerable progress has been made. While some of the details do not match, I have not heard anything that challenges the very principles involved in producing meals of high nutritive value. As our work progresses, and as our understanding of the problem increases I am sure that we can make changes in our methods of chemical evaluation of the meals which will more nearly conform to the actual biological situation.

Ward

Dr. Altschul, I thank you for your remarks and I certainly wouldn't want this meeting to adjourn without my expressing the sincere appreciation of the cottonseed crushing industry for the attendance here at this meeting, not only of research men from the experiment stations but men from the feed industry and men within our own industry. I am impressed by the great volume of very excellent work by a very superior caliber of research workers. When you stop to think about the volume of work that has been presented here in the last couple or three years, and the volume of work that has been reported here in the last two days, you cannot help but be impressed by the value of work done. I don't think that anyone could help but be impressed by the fine cooperative spirit of men from the state experiment stations, the federal stations, the regional laboratory, men from the formula feed industry, and men from the cottonseed crushing industry. This spirit of cooperation is a sure foundation for further advancement of science.

I want to point out the advantages of having a Southern Regional Research Laboratory as a center where the laboratory staff can meet with the federal and state experiment station experimenters and representatives of industry. I want to commend this excellent staff of Dr. Altschul's for the work they have presented here. We, from industry, and I know the research men at the state stations, appreciate the opportunity of sitting here for two or three days and having the opportunity of exchanging views. It means a great deal to us.

I am also impressed with the great possibilities of meetings like this as a means of bringing about coordination of research efforts. These conferences generate cooperation and prevent much duplication.

We believe in the sincere purpose of the men who are here and the men back at the stations who didn't get here, but who have done excellent work. The sincerity of purpose of these men is certainly worthy of our consideration. Sure, we are running into some bumps; but worth-while things or worth-while accomplishments are bound to come when you are undertaking to do things. Yes, we will have bumps and some disappointments, but let us not forget that real research men, the men who have research at heart are not going to be stopped. The real research men will not be lost by reason of detours. They will keep their objectives in mind and we know that we are going to make progress. The tougher the problem the greater the challenge, and I certainly want you to know that we of our cottonseed crushing industry appreciate the presence of all of you here. To me, this meeting has been a great stimulus. I thank all of you.

ATTENDANCE LIST

Barrick, Elliott R., North Carolina State College, Raleigh, N. C.
Bruins, H. W., Research Laboratories, The Quaker Oats Co., 345 E. 25th. St.,
Chicago 16, Ill.
Camp, Arthur A., Texas Agricultural Experiment Station, Route No. 2, Box 154,
Gonzales, Texas
Carroll, R. W., The Quaker Oats Company, 345 E. 25th. St., Chicago, Ill.
Cecil, E. J., Ranchers Cotton Oil Co., P. O. Box 248, Fresno, Calif.
Conly, Jean, Louisiana State University, Baton Rouge, La.
Connors, W. M., National Dairy Research Laboratories, Inc., Oakdale, Long
Island, N. Y.
Corbin, J. E., Ralston Purina Co., Chekerboard Square, St. Louis 2, Mo.
Couch, J. R., Dept. of Biochemistry & Nutrition, Agricultural & Mechanical
College of Texas, College Station, Texas
Curtin, Leo V., The Buckeye Cotton Oil Co., M.A.&R. Bldg., Ivorydale,
Cincinnati 17, Ohio
Eagle, Edward, Swift & Co., Chicago, Ill.
Ellis, N. R., Animal & Poultry Husbandry Research Branch, ARS, USDA,
Beltsville, Md.
Evans, Robert John, Department of Agricultural Chemistry, Michigan Agricultural
Experiment Station, East Lansing, Mich.
Fincher, H. D., Anderson, Clayton Co., Box 2538, Houston, Texas
Gandy, Dalton E., Educational Service, National Cottonseed Products Association,
Ruston, La.
Grau, C. R., College of Agriculture, Dept. of Poultry Husbandry, University
of California, Davis, Calif.
Harper, Garlon A., National Cottonseed Products Association, Dallas, Texas
Heidebrecht, A. Allen, Western Cottonoil Company, Abilene, Texas
Heywang, Burt W., Southwest Poultry Experiment Station, USDA, Rouge 1, Box 80,
Glendale, Arizona
Holley, K. T., Georgia Agricultural Experiment Station, University of Georgia,
College of Agriculture, Experiment, Ga.
Kuiken, K. A., The Buckeye Cotton Oil Co., Memphis, Tenn.
Lewis, Kenneth O., Educational Service, National Cottonseed Products Association,
P. O. Box 4470, Tech Station, Lubbock, Texas
Lowry, John R., General Foods Corporation, Hoboken, N. J.
Lyman, Carl, Texas Agricultural Experiment Station, Texas A. & M. College,
College Station, Texas
Morgan, C. L., Poultry Department, The Clemson Agricultural College, South
Carolina Agricultural Experiment Station, Clemson, S. C.
Pope, Charles W., Poultry Department, Louisiana State University, University
Station, Baton Rouge, La.

(over)

Rentshler, D. F., A. E. Staley Manufacturing Co., Decatur, Ill.
Sills, Morris W., USDA, Market Development Branch, Agricultural Marketing
Service, Washington 25, D. C.
Singletary, C. B., Animal Industry Department, Louisiana Agricultural
Experiment Station, LSU, University Station, Baton Rouge 3, La.
Stephenson, Edward L., Dept. of Animal Industry & Veterinary Science,
Arkansas Agricultural Experiment Station, University of Arkansas,
Fayetteville, Ark.
Wallace, H. D., Dept. of Animal Husbandry & Nutrition, Florida Agricultural
Experiment Station, University of Florida, Gainesville, Fla.
Ward, A. L., National Cottonseed Products Association, 618 Wilson Building,
Dallas, Texas
Watts, Alva B., Poultry Industry Dept., Louisiana Agricultural Experiment
Station, LSU, University Station, Baton Rouge, La.

Southern Regional Laboratory Personnel

Fisher, C. H., Altschul, A. M., Hopper, T. H., Jensen, Edith A., Mann,
Godfrey E., King, W. H., Thurber, F. H., Knoepfler, N. B., Gastrock, E. A.,
Berardi, Leah C.

